

USING MC68HC05F6 AS TONE PULSE DIALER WITH MELODY-ON-HOLD

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INTRODUCTION

The MC68HC05F6 is a fully static single chip CMOS Microcomputer. It has 288 bytes of RAM and 32 bytes of stack, 4608 bytes of ROM, on-chip oscillator, 4 I/O ports and also features a DTMF / Melody Generator (DMG), a high current port, keyboard interrupt port, Serial Peripheral Interface (SPI), 16-bit timer and a CPU core with two and four software selectable operating speeds respectively. Put simply, the MC68HC05F6 is specifically designed for telephone applications such as high end feature phones or telephone answering machines.

This application note illustrates a simple hardware and software implementation for using the MC68HC05F6 to achieve DTMF dialing, pulse dialing, pacifier tone, and melody-on-hold functions.

DTMF / MELODY GENERATOR

The DMG is a multi-functional tone generator which supports DTMF, melody, and pacifier tone generation with user-selectable frequencies. The benefit of the DMG lies in its versatility. It has sine/square wave melody and pacifier tone generators built-in, thus eliminating a significant amount of external hardware.

As shown in Figure 1, DMG is basically a DTMF generator with row and column frequency dividers, memory scanners, memories for sine wave, resistor ladders for D/A conversion, and a current summer/low-pass active filter. The time base for this module is a 3.58MHz/2 clock source which is derived from the crystal oscillator. The row and column Frequency dividers divide this clock into the lower frequencies according to the number written into Row and Column Frequency Control Registers. The output of each frequency divider drives a memory scanner that sequentially scans one of the 28 locations of a sine wave memory. The frequencies for dual tone melody are also generated by this principle. A D/A converter, which has a built-in active low-pass filter, sums the currents generated by the row and the column resistor ladders. There is also a software option for square wave melody output which is achieved by masking the least five significant bits of the output of the sine wave memory. The pacifier tone is the

signal tapped from the most significant bit of the output of Row Sine Wave Memory.

KEYBOARD INTERRUPT

Port A can be configured as a keyboard interrupt port by using software option. In the keyboard interrupt mode, this port is internally pulled high, thus a keyboard interrupt will be recognised when one of its inputs is externally pulled low.

SPEECH CIRCUIT

MC34114 is a monolithic integrated telephone speech network which incorporates the functions of transmit/receive amplification and sidetone control, each with externally adjustable gain. Loop length equalization varies the gains based on loop current. The microphone amplifier has a differential input stage designed to reduce RFI and common mode noise pick up. A MUTE* input mutes the microphone and receive amplifiers during dialing. A regulated output voltage is provided for biasing of the microphone, and a separate output voltage powers an external microprocessor. The MC34114 is designed to operate at a minimum of 1.2 volts, making party line operation possible.

DESCRIPTION OF THE TELEPHONE SYSTEM

MC68HC05F6 is designed not only for performing telephone dialing functions but also for interfacing with external peripheral, for example, a telephone answering machine. However, only the former application, but not the latter is described in this application note. Thus, many I/O lines, which should be dedicated for controlling functions, are intentionally used to drive a simple 7-segment LED display.

HARDWARE AND FUNCTIONAL DESCRIPTION

As shown in Figure 2, the telephone system consists of the MC68HC05F6, a 4x4 keyboard, two 7-segment LED displays, speech circuit MC34114P, telephone ringer MC34017-1, rectifier bridge and a transistorized pulse di-



aling circuit.

The two 7-segment LEDs are used to display the key number pressed. Note that key 'A' is displayed as '10', key '#' as '14' and key '*' as '15'.

The speech circuit MC34114 is usually powered by the telephone line through the rectifier bridge. User could select between an external floating power supply and the regulated 3.3V from VDD of MC34114 through switch S2 according to the current limit requirement. A backup battery should also be used in the latter case, as MC34114 is powered off in on-hook condition.

Either pulse or DTMF dialing can be selected through switch S3. Square wave or sine wave melody can be output by pressing '*' and '#' after switching on melody switch S4 during a conversation. A number is dialed by pressing the appropriate key, except that pressing numbers 'A' to 'D' and '*' and '#' renders no response for pulse dialing.

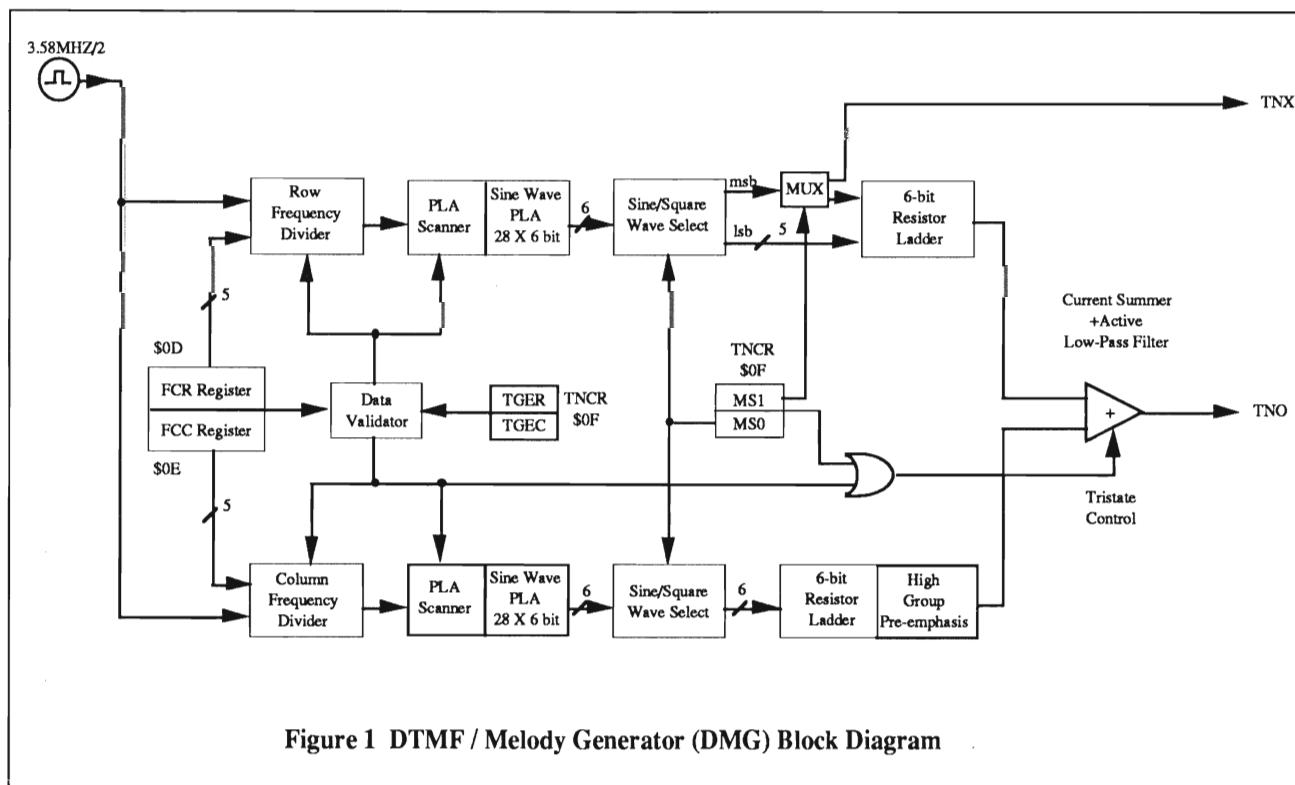
Before pulse dialing, the MS pin of the speech circuit is first set high (clear for DTMF dialing) to select pulse dialing mode, and the MUTE* pin is cleared to mute the microphone and the receiver amplifier. During pulse dialing, pulses 50ms wide and 50% mark-space ratio will be output through TCMP pin to the pulse dialing circuit. A pacifier tone will also be produced through TNX pin to the receiver according to the key pressed. The pulse dialing circuit consists of two transistors - one in a common

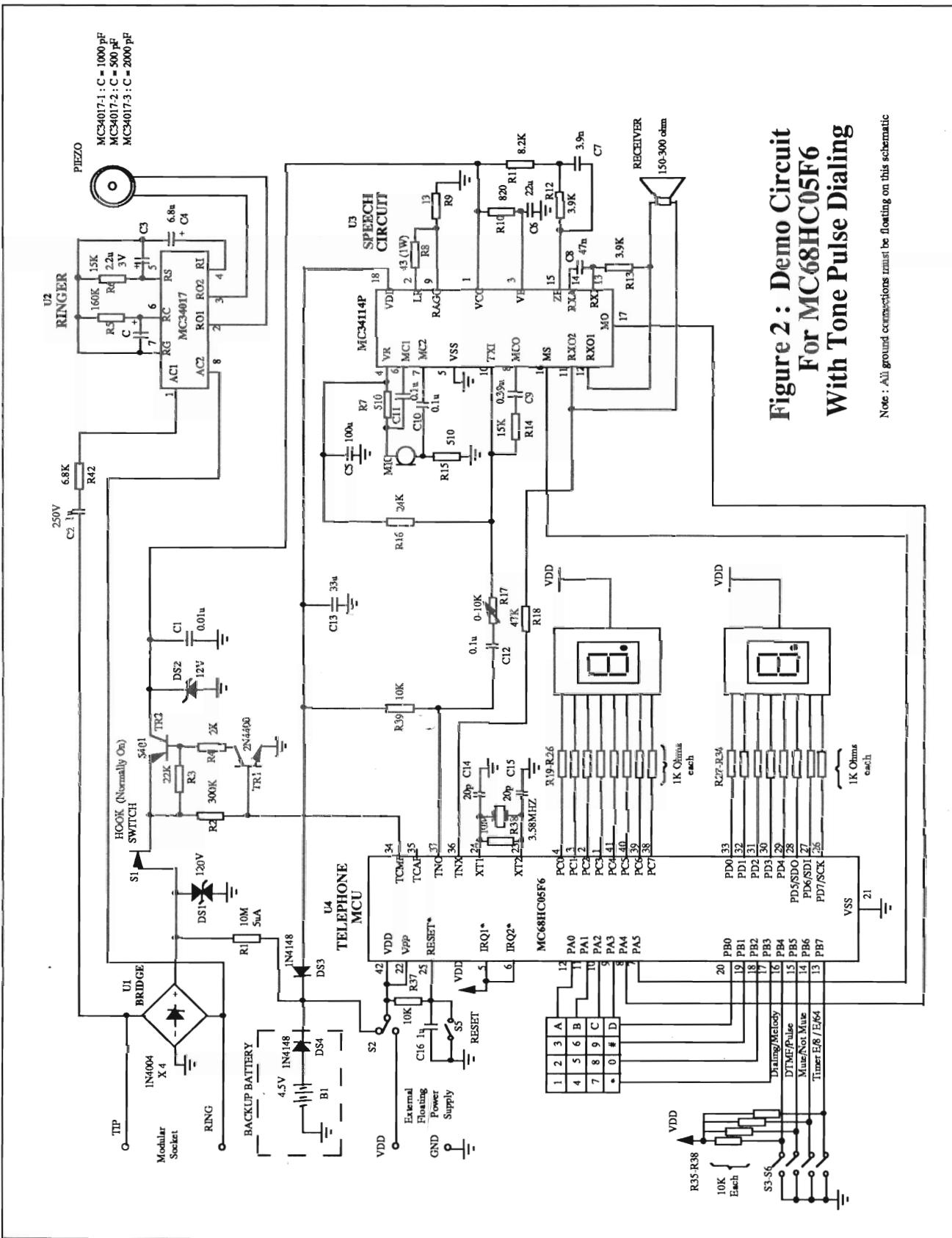
emitter and the other, a common base configuration. The TCMP, which is the output compare pin of the 16-bit timer, is set high before and after pulse dialing to bias the base of TR1. Thus, the current flows through R3 and turns on TR2, and consequently causes the loop current of about 10mA to flow. When the TCMP pin is low, transistors TR1 and TR2 will be turned off, causing the loop current to decrease. The pulse train at TCMP will therefore effect pulse dialing across tip and ring. After dialing, the speech circuit will be unmuted.

The mute and mode select operation for DTMF dialing is similar to that of pulse dialing. During DTMF dialing, DTMF tone will be generated as long as, and according to, the key pressed. An external pull-up resistor of 10K is required at the open collector output TNO. Resistor R17 is used to adjust the DTMF gain through the speech circuit. The output level of TNO is about -10dBm, but the DTMF gain when R17 is 10K is 8.5dBm. Hence, a lower resistance (i.e. about 5K Ohm) is required to bring the DTMF signals across tip and ring to an acceptable level.

SOFTWARE

Since the program is well-documented, please refer to the program listing for details.





**Figure 2 : Demo Circuit
For MCC68HCC05F6
With Tone Pulse Dialing**

Note : All ground connections must be floating on this schematic

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00004      ****
00005      *
00006      * APPLICATION PROGRAM
00007      * FOR THE MC68HC05F6
00008      *
00009      * by Michael Chang
00010      *
00011      ****
00012      *
00013      * I/O REGISTER DEFINITIONS
00014      *
00015 0000 0000 PORTA EQU $00
00016 0000 0001 PORTB EQU $01
00017 0000 0002 PORTC EQU $02
00018 0000 0003 PORTD EQU $03
00019 0000 0004 DDRA EQU $04 DATA DIRECTION REGISTER A
00020 0000 0005 DDRB EQU $05 DATA DIRECTION REGISTER B
00021 0000 0006 DDRC EQU $06 DATA DIRECTION REGISTER C
00022 0000 0007 DDRD EQU $07 DATA DIRECTION REGISTER D
00023      *
00024      * SPI REGISTERS
00025      *
00026 0000 000a SPCR EQU $0A SERIAL PERIPHERAL CONTROL
00027 0000 000b SPSR EQU $0B SERIAL PERIPHERAL STATUS
00028 0000 000c SPDAT EQU $0C SERIAL PERIPHERAL DATA
00029 0000 0007 SPIF EQU 7 SPI FLAG
00030 0000 0006 DCOL EQU 6 DATA COLLISION FLAG, BIT 6 OF STATUS REGISTER
00031      *
00032      * DMG REGISTERS
00033      *
00034 0000 000d FCR EQU $0D ROW FREQUENCY CONTROL REGISTER
00035 0000 000e FCC EQU $0E COLUMN FREQUENCY CONTROL REGISTER
00036 0000 000f TNCR EQU $0F TONE CONTROL REGISTER
00037 0000 0007 MS1 EQU 7
00038 0000 0006 MS0 EQU 6
00039 0000 0005 TGER EQU 5 ROW TONE GENERATION ENABLE
00040 0000 0004 TGEC EQU 4 COLUMN TONE GENERATION ENABLE
00041 0000 0000 FR1 EQU $00
00042 0000 0001 FR2 EQU $01
00043 0000 0002 FR3 EQU $02
00044 0000 0003 FR4 EQU $03
00045 0000 0010 FC1 EQU $10
00046 0000 0011 FC2 EQU $11
00047 0000 0012 FC3 EQU $12
00048 0000 0013 FC4 EQU $13
00049      *
00050      * NOTES DEFINITIONS
00051      *
00052 0000 0004 DS5 EQU $04
00055 0000 0007 FS5 EQU $07
00056 0000 0008 G5 EQU $08
00057 0000 0009 GS5 EQU $09
00058 0000 000a A5 EQU $0A
00059 0000 000b AS5 EQU $0B
00060 0000 000c B5 EQU $0C
00061 0000 000d C6 EQU $0D
00062 0000 000e CS6 EQU $0E
00063 0000 000f D6 EQU $0F
00064 0000 0014 DS6 EQU $14
00065 0000 0015 E6 EQU $15
00066 0000 0016 F6 EQU $16

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| | | | | | |
|-------|------|------|--------|----------|--------------------------------------|
| 00067 | 0000 | 0017 | FS6 | EQU \$17 | |
| 00068 | 0000 | 0018 | G6 | EQU \$18 | |
| 00069 | 0000 | 0019 | GS6 | EQU \$19 | |
| 00070 | 0000 | 001a | A6 | EQU \$1A | |
| 00071 | 0000 | 001b | AS6 | EQU \$1B | |
| 00072 | 0000 | 001c | B6 | EQU \$1C | |
| 00073 | 0000 | 001d | C7 | EQU \$1D | |
| 00074 | 0000 | 001e | CS7 | EQU \$1E | |
| 00075 | 0000 | 001f | D7 | EQU \$1F | |
| 00076 | 0000 | 0009 | DLY1 | EQU \$09 | |
| 00077 | 0000 | 0013 | DLY2 | EQU \$13 | |
| 00078 | 0000 | 003b | DLY6 | EQU \$3B | |
| 00079 | * | | | | |
| 00080 | * | | | | MISCELLANEOUS DEFINITIONS |
| 00081 | * | | | | |
| 00082 | 0000 | 0010 | EVENTR | EQU \$10 | EVENT ENABLE REGISTER |
| 00083 | 0000 | 0011 | MISCR | EQU \$11 | MISCELLANEOUS REGISTER |
| 00084 | 0000 | 0004 | KEYF | EQU 4 | |
| 00085 | * | | | | |
| 00086 | * | | | | TIMER REGISTERS |
| 00087 | * | | | | |
| 00088 | 0000 | 0012 | TIMCR | EQU \$12 | TIMER CONTROL |
| 00089 | 0000 | 0013 | TMSR | EQU \$13 | TIMER STATUS |
| 00090 | 0000 | 0014 | IPCAPH | EQU \$14 | INPUT CAPTURE (HIGH BYTE) |
| 00091 | 0000 | 0015 | IPCAPL | EQU \$15 | INPUT CAPTURE (LOW BYTE) |
| 00092 | 0000 | 0016 | CPCOMH | EQU \$16 | OUTPUT CAPTURE (HIGH BYTE) |
| 00093 | 0000 | 0017 | OPCOML | EQU \$17 | OUTPUT CAPTURE (LOW BYTE) |
| 00094 | 0000 | 0018 | COUNTH | EQU \$18 | COUNTER (HIGH BYTE) |
| 00095 | 0000 | 0019 | COUNTL | EQU \$19 | COUNTER (LOW BYTE) |
| 00096 | 0000 | 001a | DUALTH | EQU \$1A | DUAL TM COUNTER (HIGH BYTE) |
| 00097 | 0000 | 001b | DUALTL | EQU \$1B | DUAL TM COUNTER (LOW BYTE) |
| 00098 | 0000 | 0006 | OCF | EQU 6 | OUTPUT COMPARE FLAG, BIT 6 |
| 00099 | 0000 | 0006 | OCE | EQU 6 | OUTPUT COMPARE ENABLE, BIT 6 |
| 00100 | 0000 | 0000 | OLVL | EQU 0 | OUTPUT LEVEL AT TCMP OUTPUT |
| 00101 | 0000 | 001f | KEYCR | EQU \$1F | KEYBOARD INTERRUPT REGISTER |
| 00102 | 0000 | 002c | SYSTOP | EQU \$2C | CLOCK OPTION REGISTER |
| 00103 | 0000 | 0036 | INTE1 | EQU 6 | IRQ1 ENABLE, BIT 6 |
| 00104 | 0000 | 0004 | INTN1 | EQU 4 | IRQ1 EDGE SENSITIVITY, BIT 4 |
| 00105 | 0000 | 0006 | INTF1 | EQU 6 | IRQ1 INTERRUPT FLAG, BIT 6 |
| 00106 | 0000 | 0007 | KEYE | EQU 7 | KEYBOARD INTERRUPT ENABLE, BIT 7 |
| 00107 | 0000 | 0001 | KEYX1 | EQU 1 | KEYBOARD INTERRUPT EXTEND 1, BIT 1 |
| 00108 | 0000 | 0000 | KEYX0 | EQU 0 | KEYBOARD INTERRUPT EXTEND 0, BIT 0 |
| 00109 | 0000 | 0007 | SCS1 | EQU 7 | SYSTEM CLOCK SELECT 1, BIT 7 |
| 00110 | 0000 | 0006 | SCS0 | EQU 6 | SYSTEM CLOCK SELECT 0, BIT 6 |
| 00111 | 0000 | 0005 | TCS | EQU 5 | TIMER CLOCK SELECT, BIT 5 |
| 00112 | * | | | | |
| 00113 | * | | | | OPTION DEFINITIONS |
| 00114 | * | | | | (DEFINED BY PB4-5 INPUT PINS STATUS) |
| 00115 | * | | | | |
| 00116 | 0000 | 0005 | DILOP | EQU 5 | DIALING OPTION |
| 00117 | 0000 | 0004 | FUNOP | EQU 4 | FUNCTION OPTION |
| 00118 | * | | | | |
| 00119 | * | | | | SPEECH CCT CONTROL PIN DEFINITIONS |
| 00120 | * | | | | (DEFINED BY PA4-5 OUTPUT PIN STATUS) |
| 00121 | * | | | | |
| 00122 | 0000 | 0004 | MUTEB | EQU 4 | MUTE CONTROL (1: NOT MUTE) |
| 00123 | 0000 | 0005 | DILMD | EQU 5 | DIALING MODE (0:DTMF 1:PULSE) |
| 00124 | * | | | | |
| 00125 | * | | | | MEMORY MAP |
| 00126 | * | | | | |
| 00127 | 0000 | 0030 | COUNT | EQU \$30 | TIMER HIGH BYTE FOR DELAY SUBROUTINE |

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00128 0000 0031 KEYPOS EQU $31 KEY POSITION CODED BY COUNTING ROW AND COLUMN
00129 0000 0032 KEYNO EQU $32 KEY NUMBER ON KEY PAD
00130 0000 0033 KEYROW EQU $33 KEY ROW NUMBER
00131 0000 0034 KEYCOL EQU $34 KEY COLUMN NUMBER
00132 0000 0035 ROUND EQU $35 ROUND NUMBER OF MUSICAL PIECE
00133 0000 0036 HTEMP EQU $36 TEMPORARY LOCATION TO STORE HIGH BYTE
00134      *
00135 0000 0042 MUL    EQU $42 MULTIPLY INSTRUCTION
00136      *
00137 ****
00138      *
00139      * INITIALISATION
00140      *
00141      * BUS clock : E
00142      * Timer clock : E/8
00143      * PORT A : PA0-3 (INPUT) FOR KEYBOARD SENSING
00144      *          PA4=1 (NOT MUTE) PA5=0 (PULSE MODE)
00145      * PORT B : PB0-3 (OUTPUT ALL '0') FOR KEYBOARD SCAN
00146      *          PB4-5 (INPUT FOR OPTIONS)
00147      * PORT C : OUTPUT (OUTPUT ALL '1' ie. segment off)
00148      * PORT D : OUTPUT (OUTPUT ALL '1' ie. segment off)
00149      *
00150 ****
00151      *
00152 0d00      ORG $D00
00153 0d00 a6 e0 START  LDA #%11100000 SET MBUS CLOCK = E  TIMER CLOCK = E/8
00154 0d02 b7 2c      STA SYSOP
00155 0d04 a6 7f INTT1  LDA #$7F
00156 0d06 b7 02      STA PORTC   DISPLAY DOT IN MSB
00157 0d08 b7 03      STA PORTD   DISPLAY DOT IN LSB
00158 0d0a 33 06      COM DDRC    INIT PORTC and PORTD
00159 0d0c 33 07      COM DDRD    TO DRIVE COMMON ANODE 7-SEG LED
00160 0d0e a6 10      LDA #%0000:0000
00161 0d10 b7 00      STA PORTA   SET NORMAL SPEECH MODE
00162 0d12 a6 f0      LDA #$F0
00163 0d14 b7 04      STA DDRA
00164 0d16 3f 01      CLR PORTB
00165 0d18 43          COMA
00166 0d19 b7 05      STA DDRB
00167 ****
00168      *
00169      * -- STARTUP DISPLAY --
00170      * THE DISPLAY WILL PERFORM A COUNT DOWN SEQUENCE FROM 9 TO 0 ON *
00171      * BOTH LED WHICH THE TIME INTERVAL IS ONE SECOND. AFTERWARDS      *
00172      * THE KEYBOARD EXPECTS KEY PRESS FOR DIALING MODE OR MELODY.      *
00173      *
00174 ****
00175      *
00176 0d1b ae 09 INTRO   LDX #9
00177 0d1d a6 14 INTRO1  LDA #20      DELAY FOR 1 S
00178 0d1f b7 30      STA COUNT
00179 0d21 cd 0dc1 DEL2   JSR DELAY
00180 0d24 3a 30      DEC COUNT   DELAY FOR .05S
00181 0d26 26 f9 0d21 BNE DEL2
00182 0d28 a6 0e55 LDA TBSEG,X  FETCH SEGMENT TABLE FOR DIGIT
00183 0d2b b7 03      STA PORTD   DISPLAY LSB
00184 0d2d b7 02      STA PORTC   DISPLAY MSB
00185 0d2f 5a          DECX      .. TIMER CLOCK
00186 0d30 2a eb 0d1d BPL INTRO1
00187      *
00188 0d32 ae 09      LDX #$09    TO INITIALIZE TCMP PIN FOR DTMF AND
00189 0d34 b6 12 INITCMP LDA TIMCR  PULSE DIALING. H/W NEED.

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| | | | | |
|-------|-------------------|--|-------------------------------------|-------------------------------------|
| 00242 | 0d80 20 d6 0d58 | BRA RETURN | | |
| 00243 | 0d82 0a 0118 0d9d | BRSETDILOP,PORTB,DIAL1 | **** ACTION FOR PULSE DIALING | |
| 00244 | 0d85 be 32 | LDX KEYNO | | |
| 00245 | 0d87 a3 09 | CPX #9 | CHECK IF VALID FOR PULSE DIALING | |
| 00246 | 0d89 22 0e 0d99 | BHI NOPULS | | |
| 00247 | 0d8b cd 0e29 | JSR ECHOTX | ECHO WITH PACIFIER TONE | |
| 00248 | 0d8e ad 1a 0daa | BSR RELEAS | WAIT FOR KEY RELEASE | |
| 00249 | 0d90 3f 0f | CLR TNCR | TURN OFF TONE GENERATION | |
| 00250 | 0d92 1a 00 | BSET DILMD,PORTA | SELECT DTMF MODE FOR SPEECH CIRCUIT | |
| 00251 | 0d94 cd 0e33 | JSR PUDIAL | PERFORM PULSE DIALING | |
| 00252 | 0d97 20 bf 0d58 | BRA RETURN | | |
| 00253 | 0d99 ad 0f 0daa | BSR RELEAS | NO PULSE DIALING | |
| 00254 | 0d9b 20 bb0d58 | BRA RETURN | | |
| 00255 | * | | | |
| 00256 | * | ACTION FOR TONE DIALING | | |
| 00257 | * | | | |
| 00258 | 0d9d 1b 00 | DIAL2 | BCLR DILMD,PORTA | SELECT DTMF MODE FOR SPEECH CIRCUIT |
| 00259 | 0d9f cd 0e22 | JSR TNDIAL | PERFORM TONE DIALING | |
| 00260 | 0da2 ad 06 0daa | BSR RELEAS | WAIT FOR KEY RELEASE | |
| 00261 | 0da4 3f 0f | CLR TNCR | TURN OFF TONE GENERATION | |
| 00262 | 0da6 18 00 | BSET MUTEB,PORTA | UNMUTE AFTER EACH DIAL | |
| 00263 | 0da8 20 ae 0d58 | BRA RETURN | | |
| 00264 | * | | | |
| 00265 | 0daa b6 00 | RELEAS | LDA PORTA | CHECK IF KEY RELEASE |
| 00266 | 0dac aa 0f | | ORA #\$0F | |
| 00267 | 0dae b1 00 | | CMP PORTA | |
| 00268 | 0db0 26 f8 0daa | | BNE RELEAS | |
| 00269 | 0db2 ad 07 0dbb | | BSR DBOUNC | |
| 00270 | 0db4 b1 00 | | CMP PORTA | |
| 00271 | 0db6 27 f2 0daa | | BEQ RELEAS | |
| 00272 | 0db8 3f 01 | | CLR PORTB | PREPARE FOR NEXT SCAN |
| 00273 | 0dba 81 | | RTS | |
| 00274 | * | | | |
| 00275 | 0dbb a6 ff | DBOUNC | LDA #\$FF | |
| 00276 | 0dbd 4a | AGAIN | DECA | LOOP 1536 TIMES FOR CMOS |
| 00277 | 0dbe 26 fd 0dbd | | BNE AGAIN | |
| 00278 | 0dc0 81 | | RTS | |
| 00279 | * | | | |
| 00280 | 0dc1 1c 12 | DELAY | BSET OCE,TIMCR | PROVIDE 0.05S DELAY |
| 00281 | 0dc3 b6 1a | | LDA DUALTH | |
| 00282 | 0dc5 b7 36 | | STA HTEMP | |
| 00283 | 0dc7 a6 ed | | LDA #237 | |
| 00284 | 0dc9 bb 1b | | ADD DUALTL | |
| 00285 | 0dcb b7 17 | | STA OPCOML | |
| 00286 | 0dcf a6 0a | | LDA #10 | |
| 00287 | 0dcf b9 36 | | ADC HTEMP | |
| 00288 | 0dd1 b7 16 | | STA OPCOMH | |
| 00289 | 0dd3 b6 13 | | LDA TIMSR | |
| 00290 | 0dd5 b6 17 | | LDA OPCOML | DUMMY INSTRUCTION |
| 00291 | 0dd7 b7 17 | | STA OPCOML | |
| 00292 | 0dd9 0d 13fd0dd9 | HOLD | BRCLROCF,TIMSR,HOLD | |
| 00293 | 0ddc 1d 12 | | BCLR OCE,TIMCR | |
| 00294 | 0dde 81 | | RTS | |
| 00295 | * | | | ***** |
| 00296 | * | | | * |
| 00297 | * | DECODE SUBROUTINE | | * |
| 00298 | * | THE KEYS ARE DECODED INTO KEY POSITION(TOP AND RIGHT MOST IS 0 | | * |
| 00299 | * | AND BOTTOM AND LEFT MOST IS 15) AND KEY NUMBER (THE NUMBER ON | | * |
| 00300 | * | THE KEYPAD WITH A=11, ... *=14, #=15 etc). | | * |
| 00301 | * | | | * |
| 00302 | * | | | * |

| | | | | |
|-------|--------------|--------------------|------------------|-------------------------------------|
| 00303 | 0ddf 5f | DECCOL | CLRX | |
| 00304 | 0de0 34 34 | DDCOL | LSR KEYCOL | FIND COLUMN DETECTED |
| 00305 | 0de2 24 03 | 0de7 | BCC COLMUL | |
| 00306 | 0de4 5c | | INCX | COUNT COLUMN |
| 00307 | 0de5 20 f9 | 0de0 | BRA DDCOL | |
| 00308 | * | | | |
| 00309 | 0de7 d6 0e4d | COLMUL | LDA TBTONC,X | STORE COLUMN TONE REQ'D |
| 00310 | 0dea b7 0e | | STA FCC | |
| 00311 | 0dec a6 04 | | LDA #4 | |
| 00312 | 0dee 42 | | FCB MUL | MULTIPLY X BY 4 |
| 00313 | 0def b7 31 | | STA KEYPOS | RESULTS IN A AND STORE TO BUFFER |
| 00314 | 0df1 34 33 | DECROW | LSR KEYROW | FIND ROW DETECTED |
| 00315 | 0df3 24 05 | 0dfa | BCC GETSEG | |
| 00316 | 0df5 5c | | INCX | |
| 00317 | 0df6 3c 31 | | INC KEYPOS | COUNT ROW AND STORE KEY POSITION |
| 00318 | 0df8 20 f7 | 0df1 | BRA DECROW | |
| 00319 | * | | | |
| 00320 | 0dfa d6 0e51 | GETSEG | LDA TBTONR,X | STORE ROW TONE REQ'D |
| 00321 | 0dfd b7 0d | | STA FCR | |
| 00322 | 0dff be 31 | | LDX KEYPOS | GET KEY POSITION |
| 00323 | 0e01 d6 0e5f | | LDA TBKEY,X | TRANSLATE TO KEY NUMBER |
| 00324 | 0e04 b7 32 | | STA KEYNO | |
| 00325 | 0e06 a0 0a | | SUB #10 | IS KEY NUMBER > 10 ? |
| 00326 | 0e08 24 0a | 0e14 | BHS CARSEG | |
| 00327 | 0e0a be 32 | | LDX KEYNO | |
| 00328 | 0e0c d6 0e55 | | LDA TBSEG,X | |
| 00329 | 0e0f b7 03 | | STA PORTD | |
| 00330 | 0e11 5f | | CLRX | |
| 00331 | 0e12 20 08 | 0e1c | BRA OPSEG | |
| 00332 | 0e14 97 | CARSEG | TAX | KEY NUMBER >= 10, CARRY TO MSD |
| 00333 | 0e15 d6 0e55 | | LDA TBSEG,X | |
| 00334 | 0e18 b7 03 | | STA PORTD | |
| 00335 | 0e1a ae 01 | | LDX #1 | |
| 00336 | 0e1c d6 0e55 | OPSEG | LDA TBSEG,X | KEY NUMBER <= 10, DISPLAY AS NORMAL |
| 00337 | 0e1f b7 02 | | STA PORTC | |
| 00338 | 0e21 81 | | RTS | |
| 00339 | * | | | |
| 00340 | * | TONE DIALING | | |
| 00341 | * | | | |
| 00342 | 0e22 19 00 | TNDIAL | BCLR MUTEB,PORTA | MUTEB, PORTA |
| 00343 | 0e24 a6 30 | TNDIA1 | LDA #00110000 | ENABLE DTMF TONE GENERATION |
| 00344 | 0e26 b7 0f | | STA TNCR | |
| 00345 | 0e28 81 | | RTS | |
| 00346 | * | | | |
| 00347 | * | PACIFIER TONE ECHO | | |
| 00348 | * | | | |
| 00349 | 0e29 d6 0e6f | ECHOTX | LDA TBTNX,X | GET PACIFIER TONE |
| 00350 | 0e2c b7 0d | | STA FCR | |
| 00351 | 0e2e a6 a0 | | LDA #10100000 | ENABLE PACIFIER TONE GENERATION |
| 00352 | 0e30 b7 0f | | STA TNCR | |
| 00353 | 0e32 81 | | RTS | |
| 00354 | * | | | |
| 00355 | * | PULSE DIALING | | |
| 00356 | * | | | |
| 00357 | 0e33 be 32 | PUDIAL | LDX KEYNO | |
| 00358 | 0e35 26 02 | 0e39 | BNE PDIAL1 | |
| 00359 | 0e37 ae 0a | | LDX #10 | |
| 00360 | 0e39 19 00 | PDIAL1 | BCLR MUTEB,PORTA | MUTE SPEECH CIRCUIT |
| 00361 | 0e3b b6 12 | PDIAL2 | LDA TIMCR | |
| 00362 | 0e3d a8 01 | | EOR #00000001 | TOGGLE OP-COMPARE |
| 00363 | 0e3f b7 12 | | STA TIMCR | |

| | | |
|----------------------------|--|---------------------------|
| 00364 0e41 cd 0dc1 | JSR DELAY | |
| 00365 0e44 01 12f4 0e3b | BRCLROLVL,TIMCR,PDIAL2 | |
| 00366 0e47 5a | DECX | |
| 00367 0e48 26 f1 0e3b | BNE PDIAL2 | |
| 00368 0e4a 18 00 | BSET MUTEB,PORTA | UNMUTE BEFORE EXIT |
| 00369 0e4c 81 | RTS | |
| 00370 * | | |
| 00371 * | TABLES FOR THE 7 SEGMENT DRIVE, KEYBOARD NUMBER, AND PACIFIER TONE | |
| 00372 * | | |
| 00373 0e4d 13121110 TBTONC | FCB FC4,FC3,FC2,FC1 | DTMF COL TONES |
| 00374 0e51 00010203 TBTONR | FCB FR1,FR2,FR3,FR4 | DTMF ROW TONES |
| 00375 0e55 c0f9a4b0 TBSEG | FCB \$C0,\$F9,\$A4,\$B0,\$99 | 7-SEGMENT LEDS |
| 00376 0e5a 9282f880 | FCB \$92,\$82,\$F8,\$80,\$90 | |
| 00377 0e5f 0a0b0c0d TBKEY | FCB \$0A,\$0B,\$0C,\$0D | KEYBOARD NUMBERS |
| 00378 0e63 0306090e | FCB \$03,\$06,\$09,\$0E | |
| 00379 0e67 02050800 | FCB \$02,\$05,\$08,\$00 | |
| 00380 0e6b 0104070f | FCB \$01,\$04,\$07,\$0F | |
| 00381 0e6f 04060809 TBTNX | FCB \$04,\$06,\$08,\$09,\$0B | PACIFIER TONES |
| 00382 0e74 0d0f1416 | FCB \$0D,\$0F,\$14,\$16,\$18 | |
| 00383 * | | |
| 00384 * | MELODY PERFORMANCE : MINUET BY J.S. BACH | |
| 00385 * | | |
| 00386 0e79 3f 0f MELODY | CLR TNCR | |
| 00387 0e7b 01 3202 0e80 | BRCLR0,KEYNO,MELOD1 | |
| 00388 0e7e a6 40 | LDA #%01000000 | |
| 00389 0e80 b7 0f MELOD1 | STA TNCR | SET DMG MODE |
| 00390 0e82 5f | CLRX | RESET NOTE COUNTER |
| 00391 0e83 3f 35 | CLR ROUND | RESET TO FIRST ROUND |
| 00392 0e85 d6 0ed0 ROWTON | LDA MINUET,X | GET ROW NOTE |
| 00393 0e88 27 08 0e92 | BEQ COLTON | IF BLANK GO TO COL NOTE |
| 00394 0e8a b1 0d | CMP FCR | CHECK IF SAME NOTE |
| 00395 0e8c 26 02 0e90 | BNE ROWTN1 | |
| 00396 0e8e 1b 0f | BCLR TGCR,TNCR | STOP TONE IF SAME NOTE |
| 00397 0e90 b7 0d ROWTN1 | STA FCR | STORE TONE TO FCR |
| 00398 0e92 5c COLTON | INCX | INCREMENT NOTE COUNT |
| 00399 0e93 d6 0ed0 | LDA MINUET,X | GET COL NOTE |
| 00400 0e96 27 080ea0 | BEQ BEAT | IF BLANK GO TO BEAT DELAY |
| 00401 0e98 b1 0e | CMP FCC | CHECK IF SAME NOTE |
| 00402 0e9a 26 020e9e | BNE COLTN1 | |
| 00403 0e9c 19 0f | BCLR TGEC,TNCR | STOP TONE IF SAME NOTE |
| 00404 0e9e b7 0e COLTN1 | STA FCC | STORE TONE TO FCC |
| 00405 0ea0 cd 0dc1 BEAT | JSR DELAY | TURN ON BOTH PATH |
| 00406 0ea3 b16 0f | LDA TNCR | |
| 00407 0ea5 aa 30 | ORA #%00110000 | |
| 00408 0ea7 b7 0f | STA TNCR | |
| 00409 0ea9 5c | INCX | INCREMENT NOTE COUNT |
| 00410 0eaa d6 0ed0 | LDA MINUET,X | GET BEAT DELAY |
| 00411 0ead b7 30 | STA COUNT | |
| 00412 0eaf cd 0dc1 DEL3 | JSR DELAY | |
| 00413 0eb2 3a 30 | DEC COUNT | |
| 00414 0eb4 26 f9 0caf | BNE DEL3 | |
| 00415 0eb6 3d 35 | TST ROUND | |
| 00416 0eb8 26 0c0ec6 | BNE NXTON1 | **** ROUND 0 **** |
| 00417 0eba a3 59 | CPX #89 | END OF FINE1 ? |
| 00418 0ebc 26 050ec3 | BNE NXTON3 | NEXT NOTE |
| 00419 0ebe 5f | CLRX | RESET NOTE COUNT |
| 00420 0ebf 33 35 | COM ROUND | INCREMENT ROUND COUNT |
| 00421 0ec1 20 c20e85 | BRA ROWTON | |
| 00422 0ec3 5c NXTON3 | INCX | **** ROUND 1 **** |
| 00423 0ec4 20 bf0e85 | BRA ROWTON | TO FINE2? |
| 00424 0ec6 a3 4d NXTON1 | CPX #77 | |

| | | | | | |
|-------|---------------------------|--------|------------|--------------------|--|
| 00425 | 0ec8 26 | 020ecc | BNF NXTON2 | | |
| 00426 | 0eca ae | 5f | LDX #95 | GO FINE2 | |
| 00427 | 0ecc a3 | 71 | NXTON2 | CPX #113 | |
| 00428 | 0ece 26 | f30ec3 | BNF NXTON3 | END OF FINE2 ? | |
| 00429 | * | | | | |
| 00430 | * TABLE FOR DTMF & MELODY | | | | |
| 00431 | * | | | | |
| 00432 | 0ed0 | 1b0409 | MINUET | FCB AS6,DS5,DLY1 s | |
| 00433 | 0ed3 | 040009 | | FCB DS5,0,DLY1 d | |
| 00434 | 0ed6 | 060009 | | FCB F5,0,DLY1 r | |
| 00435 | 0ed9 | 080609 | | FCB G5,F5,DLY1 m | |
| 00436 | 0edc | 090009 | | FCB GS5,0,DLY1 f | |
| 00437 | 0edf | 0b0813 | | FCB AS5,G5,DLY2 s | |
| 00438 | 0ee2 | 040013 | | FCB DS5,0,DLY2 d | |
| 00439 | 0ee5 | 040013 | | FCB DS5,0,DLY2 d | |
| 00440 | 0ee8 | 0d0913 | | FCB C6,GS5,DLY2 1 | |
| 00441 | 0eeb | 090009 | | FCB GS5,0,DLY1 f | |
| 00442 | 0eee | 0b0009 | | FCB AS5,0,DLY1 s | |
| 00443 | 0ef1 | 180009 | | FCB G6,0,DLY1 m | |
| 00444 | 0ef4 | 0f0009 | | FCB D6,0,DLY1 t | |
| 00445 | 0ef7 | 140813 | | FCB DS6,G5,DLY2 d2 | |
| 00446 | 0efa | 040009 | | FCB DS5,0,DLY1 d | |
| 00447 | 0efd | 040009 | | FCB DS5,0,DLY1 d | |
| 00448 | 0f00 | 090613 | | FCB GS5,F5,DLY2 f | |
| 00449 | 0f03 | 0b0009 | | FCB AS5,0,DLY1 s | |
| 00450 | 0f06 | 090009 | | FCB GS5,0,DLY1 f | |
| 00451 | 0f09 | 080009 | | FCB G5,0,DLY1 m | |
| 00452 | 0f0c | 060009 | | FCB F5,0,DLY1 r | |
| 00453 | 0f0f | 080413 | | FCB G5,DS5,DLY2 m | |
| 00454 | 0f12 | 090009 | | FCB GS5,0,DLY1 f | |
| 00455 | 0f15 | 080413 | | FCB G5,DS5,DLY2 m | |
| 00456 | 0f18 | 060009 | | FCB F5,0,DLY1 r | |
| 00457 | 0f1b | 040009 | | FCB DS5,0,DLY1 d | |
| 00458 | 0f1e | 040b13 | FINE1 | FCB DS5,AS5,DLY2 d | |
| 00459 | 0f21 | 040809 | | FCB DS5,G5,DLY1 d | |
| 00460 | 0f24 | 060009 | | FCB F5,0,DLY1 r | |
| 00461 | 0f27 | 080b13 | | FCB G5,AS5,DLY2 m | |
| 00462 | 0f2a | 060009 | | FCB F5,0,DLY1 r | |
| 00463 | 0f2d | 001909 | | FCB 0,GS6,DLY1 f | |
| 00464 | 0f30 | 060913 | FINE2 | FCB F5,GS5,DLY2 r | |
| 00465 | 0f33 | 080b09 | | FCB G5,AS5,DLY1 m | |
| 00466 | 0f36 | 060009 | | FCB F5,0,DLY1 r | |
| 00467 | 0f39 | 040b09 | | FCB DS5,AS5,DLY1 d | |
| 00468 | 0f3c | 060009 | | FCB F5,0,DLY1 r | |
| 00469 | 0f3f | 04003b | | FCB DS5,0,DLY6 d | |
| 00470 | * | | | | |
| 00471 | 1ffe | | | ORG \$1FFE | |
| 00472 | 1ffe | 0d00 | RSTV | FDB START | |
| 00473 | 1ff8 | | | ORG \$1FF8 | |
| 00474 | 1ff8 | 0d46 | KEYV | FDB KEYSNC | |
| 00475 | | | | END | |

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